A TAXONOMIC STUDY OF LILIACEAE SENSU LATO:
I- NUMERICAL ANALYSIS

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Introduction

Liliaceae has been the center of many phylogenetic considerations, too much debate and controversy with regard to its delimitation and to the taxonomic status of some of its minor taxa. The disputed delimitation of this family is due to the fact that some taxonomists take different attitudes to "the important" criteria prior to setting up their classification. In Krause's (1930) system of classification the relative position of the ovary was considered distinctive for the family; being superior in Liliaceae and inferior in Amaryllidaceae. In Hutchinson's (1934) system the umbellate inflorescence, irrespective of ovary relative position, was regarded as distinct for Liliaceae. Cronquist (1968) submerged Amaryllidaceae in Liliaceae on the belief that none of these criteria is solely sufficient for the separation of two families. Furthermore, the controversy in the taxonomic status of the minor groups has, in most cases, been relying upon relatively few characters. For instance, Hutchinson (1973) regarded the bracteate taxa of Anguillareae as a separate more advanced tribe, viz Iphigenieae, so that his amended concept of Anguillareae included only the ebracteate taxa. A comparison between some of the widely followed systems is presented by Becker (1973) and Traub (1974).

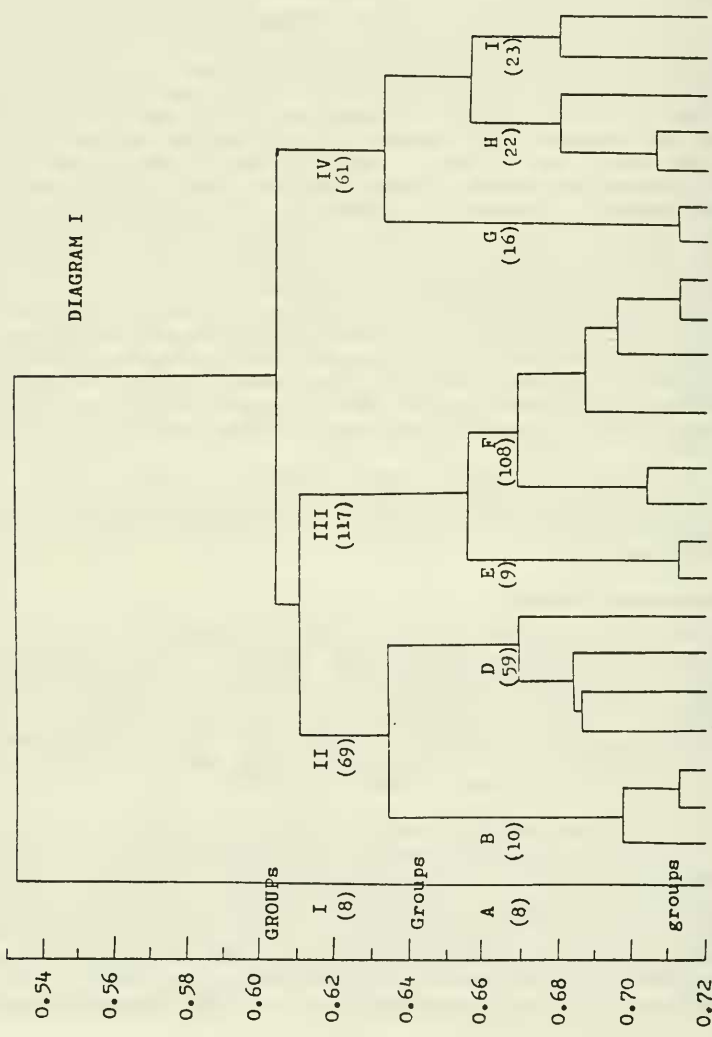
In numerical taxonomy many characters are used in setting up the classification with no overweighing of some characters before analysis. An approach which may overcome the unavoidable defects of the traditional approaches.

Material and methods:

A cosmopolitan sample of 255 species representing 104 genera from Liliaceae sensu Engler (1888) were selected for the purpose of this study. This represents about 7.5% and 52.3% of the total number of species and genera. All Engler's tribes except Calectasieae and all his subtribes except Asphodeleae-Xeroneminae and Aloineae-Kniphofinae are represented in this sample. All species names have been updated in the Index-Kewensis and its supplements; these are given in Appendix I.

It seems reasonable to employ the simplest and the least time-consuming techniques. The species have been investigated through herbarium specimens recovered, prior to any investigation, by boiling (of only those parts to be examined) in water for 5-10 minutes. Clearing in warm lactic acid proved to be indispensable for recording several characters of foliage and perianth leaves and gynoecia. The pollen preparations have been made according to the method of Franks and Watson (1963). Free-hand sections of stems and peduncles have been studied through semi-

Diagram I, Hierarchical representation of the proposed arrangement to the 25 groups level, with the No. of species in parentheses. The species within the groups are given in Appendix I.



permanent preparations stained in phloroglucinol and conc. Hcl using glycerin jelly as a mountant.

Observations and numerical analysis:

Fifty-four morphological and anatomical characters have been recorded comparatively for all species. In numerical analysis coding is the most critical part; there is always discordancy regarding the fate of most characters to be coded. Therefore, a set of coded characters (see Table 1) was made to cover as much as possible aspects of variations in order to cover any operational or human error or misjudgment. However, some criteria are so difficult to define into appropriate states. These are left out of the computational analysis together with those characters in which the literature was consulted to fill the gaps resulting from lack of some parts (e.g. the fruit) from the herbarium specimens. These characters are given in Table 2 . The coded data were analysed by an agglomerative polythetic based on the most frequently used clustering strategy known as the unweighted pair groups method using arithmetic averages (UPGMA).

Results and the proposed arrangement:

The result of this analysis is given in the form of a dendrogram in the computer print out to the species level (agglomerative analysis). From which the hierarchical arrangement of the examined 255 species are drawn only to the 25 groups level. It seems reasonable to interpret the hierarchy at 3 different similarity levels. At 0.162 the taxonomic groups are termed GROUPs, those at 0.655 are Groups, while those at 0.713 are groups.

It is of vital importance that computed results should be scrutinized for any obvious errors or misclassification (in terms of the original recorded characters). Hence, a few realignments have been made, incorporating the shift of 11 species. These realignments reduced the number of Groups to 8 and the number of groups to 23.

The hierarchy of the proposed arrangement to that 25 groups level (after realignments) is given in Diagram 1. The distribution of species in each group is given in Appendix 1.

Taxonomic evaluation of the srrangement:

1. Internal evidence:

At all levels the groups in the present arrangement of Liliaceae sensu lato in Appendix I and Diagram I are based on character correlations as seen in Table 1. In this table the distribution of each character subjected to computation among the 'groups' of the proposed arrangement

is given. The data matrix showing the recorded characters of individual species can be obtained on request. The value of presenting this table lies mainly in its relative compactness (and hence the ease of inspection and comparison between groups), and its consistency in showing the distribution of all characters in different groups. From this table, combination of characters on which the "groups" at the 4 GROUPs level and at the 9 Groups level can be easily picked out.

GROUP I includes the examined 8 species of tribe Veratreae. Members of this GROUP are characterized by the presence of raphides in leaves (12); the multinerved tepals (VII, 2) hairy tepals (19); globoid anthers (30); and distinct styles (24).

GROUP II, unlike any other GROUP includes most species which are devoid of raphides. It includes the 17 examined species of Engler's Lilioideae-Tulipeae, 30/38 species Allioideae plus 16/36 species of Melanthioideae. Within this GROUP, the presence of umbellate inflorescence (1,2), globoid anthers (30), lobed stigma (26), hairy tepals (19), uninerved tepals (VII, 1) and distinct subsidiary cells (11) distinguish Group II-D from Group II-B.

Most species of GROUP III are characterized by the frequent occurrence of raphides: in their leaves (12), tepals (18), ovaries (22) and in style (25). GROUP III combines Group III-E which consists mainly of Aloineae together with Group III-E. The latter binds most of the examined species of Asphodeloideae and all species of Dracaenoideae, Ophiopogonoideae and Aletroideae together with Liliodieae-Scilleae.

In GROUP III, the hairy tepals and ovaries, the paniculate and the umbellate inflorescences, and the distinct styles are restricted to members of Group III-F. This latter Group can be further distinguished from Group III-E (Aloineae-Aloinae) on the basis of many characters (e.g. 6, 28, 29, 30 and III, 3). In otherwords this analysis emphasizes the distinction between Asphodeloideae-Aloineae-Aloinae (Group III-E) and other tribes of Asphodeloideae in Group III-F.

GROUP IV includes, among others, the studied species of Herrerioideae, Luzuriagoideae, Smilacoideae and most Asparagoideae. From Table 1 the axillary position of the flowers seems to be the distinguishing feature of the GROUP. This GROUP is subdivided to accomodate 4/4 species of Asparagoideae-Pariideae and 10/12 species of Melanthioideae-Uvularieae in Group IV-G; 3/3 species of Herrerioideae-Herrerieae, 8/8 species of Smilacoideae and 5/13 Asparagoideae-Polygonateae among others in Group IV-H; while all Asparagoideae-Asparageae (16/16 species), the examined species of Asparagoideae-Convallarieae-Convallarinae with 5/13 species of Asparagoideae-Polygonateae are in Group IV-I. The acceptance of these Groups hits across Engler's Asparagoideae. However, the tribes Asparageae and Pariideae withstand the disruption at this level of the arrangement, while Polygonateae is seriously disrupted.

Table 1. Distribution of the characters subjected to computation among the nine Groups of the proposed arrangement set out in Appendix I and Diagram I. Complete absence of a character in Group is indicated by '-'.

Computed characters \ GROUPs	I	II		III		IV		
Groups	A	B	D	E	F	G	H	I
total no. of spp.	8	10	59	9	108	16	22	23
1 Flowers or inflorescence axillary	-	-	1	-	-	16	20	18
2 Flowers bisexual	8	10	57	7	106	16	16	19
3 Peduncles carry foliage leaves	-	3	20	-	6	-	1	-
4 Leaves on a long stem	6	-	2	3	4	15	22	23
5 Cladode or phylloclade present	-	-	-	-	-	-	1	16
6 Cuticle on stem thin	7	8	22	1	57	13	6	14
7 Stomata levelled with stem epidermal cells	7	10	48	9	103	14	17	23
8 Vascular bundles in stem cross section scattered	2	7	19	4	60	13	22	18
9 Stem with cortical fibrous ring	7	-	33	8	79	14	21	22
10 Chlorenchyma in stem cross section present	7	6	48	6	90	11	19	15
11 Subsidiary cells distinguished from epidermal cells	-	-	22	8	42	-	3	7
12 Raphides detected in leaves	7	4	3	8	96	4	23	20
13 Tepals similar in size and shape	1	3	19	5	20	2	5	10
14 Tepals united	3	8	4	7	52	1	7	1
15 Union extends the whole length of tepals	-	7	2	3	19	1	1	1
16 Papillae present on tepals	2	3	16	2	77	9	19	2
17 Papillae only on apical parts of tepals	-	2	11	2	70	4	14	2
18 Raphides detected in tepals	6	1	1	8	101	4	21	20
19 Tepals hairy	7	-	11	-	27	7	11	1
20 Ovary hair	3	-	-	-	5	-	-	-
21 Ovary surface papillated	1	1	7	2	18	1	2	-
22 Raphides detected in ovary	6	2	1	6	94	2	15	22
23 Style not deeply inserted in ovary	8	3	45	8	90	16	16	22

24 Style distinct	7	6	10	-	9	11	-	9
25 Raphides detected in style	4	-	2	6	54	2	5	8
26 Stigma lobed	-	-	18	1	37	6	4	10
27 Staminal filament glabrous	7	8	52	8	102	15	18	19
28 Stamens inserted on perianth	6	9	8	2	52	-	11	15
29 Staminal filament broad	5	4	46	2	71	4	15	18
30 Anthers bloboid	7	-	17	2	24	-	2	9
I Flowers or inflorescence.								
State 1, Solitary	-	7	13	-	1	13	4	9
State 2, umbellate	-	-	30	-	9	-	9	1
State 3, corymbose	-	-	-	-	2	-	-	-
State 4, recemose	2	3	16	9	70	3	9	13
State 5, paniculate	6	-	-	-	26	-	-	-
II Leaf arrangement.								
State 1, alternate	4	-	9	4	2	11	14	22
State 2, opposite	-	-	5	-	2	-	1	1
State 3, whorled	-	-	3	-	3	5	7	-
State 4, clustered at base of scape or peduncle	4	8	15	4	73	-	-	-
III Leaf nature.								
State 1, foliage	8	10	59	2	108	16	22	7
State 2, scaly	-	-	-	-	-	-	-	13
State 3, succulents	-	-	-	7	-	-	-	-
State 4, spiny	-	-	-	-	-	-	-	3
IV Leaf shape.								
State 1, tubular	-	1	12	1	7	-	-	-
State 2, linear	3	7	43	6	93	-	7	1
State 3, ovate	5	2	4	2	8	16	12	5
State 4, hastate	-	-	-	-	-	-	3	1
V Leaf surface.								
State 1, glabrous	3	10	59	4	100	12	22	7
State 2, worty	-	-	-	2	1	-	-	-
State 3, spiny	-	-	-	3	2	-	-	-
State 4, hairy	5	-	-	-	5	4	-	-
VI Root stock.								
State 1, rhizome	5	2	7	6	45	10	10	6
State 2, corm	-	6	3	-	-	-	2	-
State 3, bulb	1	2	47	2	39	-	-	-
VII Venation of tepals.								
State 1, uninerved	-	-	27	1	72	-	13	23
State 2, multinerved	8	9	20	8	33	1	9	-
State 3, reticulate	-	1	12	-	3	15	-	-

Within GROUP IV the reticulate venation of the tepals is restricted to members of Group IV-G. The distinction of this Group (mainly Melanthioideae-Uvularieae) can be further substantiated (see Table 1). Characters number 5, 16, 24 and 11,3 in Table 1 reflect some aspects of the variations exhibited between members of Group IV-H and Group IV-I. Eustrephus latifolius in Group IV-H possesses leafy stems; a character which otherwise is restricted to members of Group IV-I. However, in the former species the presence of the leafy stems is associated with hairy tepals while in Group IV-I, their presence is associated with glabrous tepals.

External evidence:

A defensible taxonomic scheme must possess a certain peridictive value. Therefore, in addition to the recorded information which was included in the computation, more criteria were recorded for all the species. The distribution of these characters among the Groups is given in Table 2. The record of these features for each species is given in Elwan (1979). Also, all known cromosomal counts for the species under investigation have been compiled from different sources. These are: Darlington and Wylie (1961), Ornduff (1967, 1968), Moore (1973, 1974), Fedorov (1976). Also the IOPB chromosome number reports presented periodically by Askell and Löve in Taxon have been consulted.

From Table 2 it is evident that the proposed arrangement gains additional support. Thus with the exception of some Ophiopogonoideae, Asparagoideae, Dracaena and Dianella in Group III-F, the berry type of fruit is confined in GROUP IV. In GROUP II and GROUP III there is a tendency towards the absence of bundle sheath. However, this tendency is more prominent in GROUP II which comprises 30/38 spp. of Allioideae and 17/17 spp. of Lilioideae-Tulipeae. In GROUP IV the bundle sheath is present in most species.

At lower reaches of the hierarchy, the distinction between the "groups" is even more sound. Within GROUP II the distinction between members of Group II-B (which comprises Colchiceae and 4 other species) and those of Group II-D (which includes Lilioideae-Tulipeae among others) can be emphasized in terms of many characters (see no. 7, 13 and 15 in Table 2). Also within GROUP III, the distinction between Group III-E (mainly Aloineae-Aloinae) and Group III-F (which includes most of Asphodeloideae, Lilioideae, Scilleae, Dracaenoideae, Ophiopogonoideae and Alteroideae) can be emphasized in terms of characters no. 1, 2, 8, 11, 13 and 17 (see Table 2). Fiurthermore, within GROUP IV, the distinction between Group H and I at one hand and Group G on the other (see Diagram I) is quite clear in terms of character no. 10-13 (see Table 2).

One should also point out that some "groups" are seemingly "good" in terms of chromosomes counts. For instance, the chromosome number for most species is frequently in multiple of 7, 8 and 9 in all GROUPs except in GROUP IV, where most species have x=10. The latter GROUP includes most of Asparagoideae, Luzuriagoideae, Herrerioideae, Smilacoideae among others. Also the distinction within GROUP II between

Table 2 : Distribution of the characters recorded for 255 species of Liliaceae sensu lato and not subjected to numerical analysis. The complete absence of a character in a group is indicated by '-'.

	GROUPs	I	II		III		IV		
	Groups	A	B	D	E	F	G	H	I
	Characters	8	10	59	9	108	61	22	23
1	Fruits berries	-	-	-	-	13	4	15	22
2	Flowers hairy	4	-	1	-	6	1	-	-
3	Stipules present	-	-	-	-	-	-	6	-
4	Leaves with spiny apex	-	-	-	4	1	-	1	-
5	Stem glabrous	-	3	17	7	52	11	17	22
6	Bundle sheath present	7	2	10	4	49	9	18	20
7	Stomata on leaves sunken	-	-	16	2	8	1	-	-
8	Druses in leaves	-	1	3	-	4	2	-	-
9	Solitary crystals in leaves	-	-	1	-	4	4	2	2
10	Druses in overies	-	-	4	-	2	4	-	-
11	Solitary crystals in overies	1	-	3	-	3	5	-	-
12	Style papillated	-	-	3	1	7	5	-	-
13	Style very short	6	-	13	-	11	-	6	14
14	Style long	-	8	18	4	42	10	7	2
15	Pollen grains smooth	1	-	17	1	10	1	3	7
16	Pollen grains granulose	1	10	38	7	79	9	16	11
17	Pollen grains reticulate	6	-	4	-	19	5	3	1

Group II-B and Group II-D is meaningful in terms of chromosome counts. Thus, while members of the former Group (Colchiceae among others) have chromosomes predominantly in multiples of 9 or 17, those of the latter (Lilioideae-Tulipeae among others) have chromosomes mostly in multiples of 8. Similarly within GROUP III, the multiples of 8 chromosome counts are strictly confined to members of Group III-F, while those of Group III-E have chromosomes mainly in multiples of 7. Within GROUP IV, there is an apparent tendency in Group IV-G for the chromosomes to be in multiples of 7, 10, 11 and 13; while in Group IV-H the chromosomes are mainly in multiples of 8, 9 and 10.

Conclusion

From Tables (1 & 2), it is clear that some of the proposed groupings are "better" than others (viz based on manifest correlations among characters). The correlation reflected among members of GROUP IV is so evident, however, GROUP III reflects slight correlations between characters but this may be merely due to its large size. However, at lower reaches of the hierarchy, some groups are well defined. The recognized taxa, other than genera which appear intact in the present analysis at 25 groups level (and consequently at higher levels) are; Veratreae (Engler, Hutchinson) in group 1., Colchiceae (Engler, Hutchinson) in group 4, Tulipeae (Hutchinson, Engler, Melchoir, 1964) in group 7; Hutchinson's Aloineae = Melchoir's Aloeae in group 11, Aletroideae (Engler, Melchoir) in group 18, Engler's Pariideae = Hutchinson's Trilliaceae in group 19, Herrerieae (Hutchinson, Melchoir) in group 22.

At nine Groups level the taxa which appear intact are: Anguillarieae (Hutchinson, Engler) in Group D; Gilliesieae (Engler, Melchoir) in Group D; Asphodeleae-Anthericinae (Engler) in Group F; Asphodeleae-Eriosperminae (Engler, Melchoir) in Group F; Engler's Asphodeloideae-Hemerocalloideae = Melchoir's Hemerocalleae in Group F; Ophiopogonoideae (Engler, Melchoir) in Group F.

At four GROUPs level the taxa which appear intact are: Melchoir's Simlacoideae = Hutchinson's Smilacaceae, Engler's Luzuriagoideae = Hutchinson's Philesiaceae, Asparageae (Engler, Melchoir) in GROUP IV; and Dracaenoideae (Engler) in GROUP III.

Some of the represented groups are seemingly homogenous in terms of well recognized taxa; thus group 1 includes Verateae; group 2 includes only Scilleae p.p; group 3 includes only Colchiceae; group 6 includes only Anguillarieae; group 11 includes only Aloineae-Aloinae; group 13 only Dracaenae p.p.; while Asparageae sensu Melchoir is in Group IV-1.

The taxa which seem to suffer most disruption and which fail to appear in only one of the 4 main GROUPs are Scilleae, Asphodeleae, Holonieae, Tofieldieae, Johnsonieae, Polygonateae and Lomandreae.

However, the disruption of some of these taxa may be attributed to i) Deficiency on behalf of the machinary, ii) Any human error incorporated in the analysis iii) The sample under investigation represents quite a heterogenous taxon (Liliaceae sensu lato) so that the recorded characters could not reflect the actual relationships among all of its groupings. However, it is hoped that the present study might contribute to similar studies in the taxonomy of liliaceous taxa. It also may direct the attention towards the appropriate characters necessary for monographic studies concerning particular taxa.

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Appendix 1: The distribution of 255 species of Liliaceae sensu lato among the 25 groups of GROUPs I-IV in diagram 1.

GROUP I

Group A

Group 1:
Veratrum grandiflorum Maxim., V. eschscholtzia Gray, V. californicum Durand., V. stamineum Maxim., V. album Linn., Zygadenus paniculatus S. Wats., Z. mattalii A. Gray, Melanthium virginicum Linn.

GROUP II

Group B

Group 2:
Hyacinthus orientalis Linn., Muscari paradoxum C. Koch

Group 3:
Heloniopsis breviscapa var. albiflora Maxim.,
H. orientalis Thunb.

Group 4:
Colchicum arenarium Waldst. et Kit., C. autumnale Linn., C. cornigerum Linn., C. luteum Baker, C. montanum Linn., Merendera robusta Bunge

Group D

Group 6:
Dipidax ciliata Baker, D. rosea Laws.

Group 7:
Calochortus splendens Dougl. ex Benth., C. uniflorus Hook, et Arn., Erythronium dens-canis Linn., Fritillaria arianum Losinks. et Vved., F. atropurpurea Nutt., F. liliacea Lindl., F. meleagris Linn., F. roylei Hook., F. tenella Bieb., Gagea bracteolaris Salisb., G. dshungarica Regel, G. fascicularis Salisb., G. fibrosa Schult., G. mauritanica Schult., G. liotardi Schult., G. minima Ker-Gawl., G. persica Boiss., Gilliesia graminea Lindl., G. monophylla Reiche, Lilium maritimum Kellogg, L. martagon Linn., Lloydia alpina Salisb., Miersia chilensis Lindl., Tulipa cretica Boiss. et Heldr., T. greigi Regel, T. oculus-solis Saint-Amans, T. stellata Hook., T. sylvestris Linn.

Group 8:
Allium ampeloprasum Linn., A. artemisietorum Eig et Feinbr, A. aschersonianum Barbey, A. barthianum Aschers. et Schweinf, A. blomfieldianum Aschers. et Schweinf, A. carinatum L., A. cepa Linn., A. curtum Bioss. et Gillard, A. desertorum Forsk., A. erdelii Zucc., A. monophyllum Vved., A. flavum Linn., A. narcissiflorum Vill., A. paniculatum Linn., A. roseum Linn., Androcymbium gramineum Macbride, Asphodelus acaulis Desf., Eremurus kopatdagensis Hort. ex Karrer, Nothoscordum bivalve (L.) Britt., N. fragr Kunth, N. texanum M.E. Jones, Sowerbaea juncea Linn., Tulbaghia alliacea var. ludwigiana Linn.

Group 9:
Alania cunninghami Steud., Anguillaria dioice R. Br., Baeometra columel-

laris Salisb., Chinographis japonica Maxim., Tofieldia calyculata Wahlenb., T. palustris Huds.

GROUP III
Group E

Group 10:

Dipcadi erythraeum Webb et Berth., Muscari neglectum Guss. ex Tenoro.

Group 11:
Aloe metriformis Mill., A. spinosisima Hort. ex Jahandiez, A. vera Linn., Gasteria maculata Haw., Haworthia fasciata Haw., H. margaritifera Haw., H. reticulata Haw.

Group F

Group 12:
Nolina lindheimeriana S. Wats., Odontostomum hartwegii Torr.

Group 13:
Astelia alpina R. Br., A. argyrocoma A. Hell.

Group 15:
Anthericum ramosum Linn., Asphodelus microcarpus Viviani, Chlorogalum angustifolium Kellogg, Cholorophytum elatum R. Br., Dianella revoluta R. Br., Hemerocallis aurantiaca Baker, H. fulva Linn., Thysanotus dichotomus R. Br.

Group 16:
Dracaena afromontana Mildbread, Massonia angustifolia Linn.

Group 17:
Albuca major Linn., A. minor Linn., Anthericum angustifolium Hochst., A. capitatum Vill., A. fasciculatum Baker, Asphodelus albus Willd, A. fistulosus v. tenuifolius L., A. pendulinus Coss. et Dur., A. ramosus Linn., A. tenuifolius Gav., Bulbino asphodeloides Spreng., Bulbinella caudata Kunth, B. gracilis Kunth., Camassia cusickii S. Wats., Chlorophytum amplexicaule Baker, C. bakeri Poella., C. norlindhii Bak., Clintonia alpina Kunth., C. borealis Rafin., Dasylirion acrostichum Zucc., Dipicadi serotinum Medic., D. unifolium Baker, Echeandia brevifolia Wats., Eremurus himalaicus Baker, E. spectabilis Bieb., Eriospermum abyssinicum Baker, E. bakerianum Schinz., E. burchellii Baker, Eucomis punctata L. Herit., Hyacinthus amethystinus Linn., Liriope muscari v.variegata L. H. Bailey., L. spicata Lour., Lomandra ettrisa (R.Br.) J. Britten, Milla biflora Cav., Muilla maritima S. Wats., Narthecium ossifragum (L.) Huds., Nolina longifolia (Karra) Hemsl., Ophiopogon formosanus Ohwi, Ornithogalum brachystachys Hort. Gorenk ex Schult., O. comosum Linn., O. narbonense Linn., O. tenuifolium Guss., Peliosanthes neilgherriensis Wight., Scilla autumnalis Linn., S. bifolia Linn., S. yemensis Deflers, Sowerbaea laxiflora Lindl., Urginea grandiflora Baker, U. scilla Steinh., Xerophyllum asphodeloides (L.) Nutt., Yucca aloifolia Linn., Y. filamentosa Linn.

Group 18:
Agapanthus africanus Leighton, A. campanulatus (L.) Hoffm., A. umbellatus L'Herit, Aletris aurea Walt,, A. bracteata Northrop, A. farinosa Linn., A. spicata Thunb., Anthericum jacquinianum Schult., Aphyllanthes monspliensis Linn., Bloomeria crocea (Torr.) Cav., Brodiaea congesta Sm., B. laxa S. Wats., Chionodoxa luciliae Boiss., Cordyline stricta Endl., C. terminalis Kunth., Dracaena elliptica Thunb., D. fragrans Ker-Gawl., Drimia hyacinthoides Baker, D. media Jacq., Hosta albomarginata (Hook.) Ohwi., H. longissima Honda, Hyacinthus alexandrina Feinbr., H. flexuosus Baker , H. macrobotrys Baker , H. mauritanica Pomel., H. sessiliflorus (Viv.)Kth., Lachenalia algoensis Schone., L. comptonii Baker , L. tricolor Jacq., Muscari bicolor (Boiss.) Eig. et Feinbr., M. comosum (L.) Mill., M. eburnea Eig. et Feinbr., M. maritimum Desf., M. moschatum Willd., M. holzmanni Hirc., M. racemosum Mill. Gard., Rohdea japonica Rolh., Sansevieria cylindrica Boj., S. trifasciata Hort. ex Prain., Scilla festalis Salisb., S. peruviana Linn., Urginea undulata Steinh.

GROUP IV
Group B

Group 19:
Gloriosa rothschildiana O'Brien., G. simplex Linn., Medeola virginiana Linn., Paris quadrifolia Linn., Philesia magellanica J.F. Gmel., Tricyrtis affinis var affinis Makin., T. formosana Baker, T. hirta var. parviflora Hooker, T. latifolia Maxim., Trillium cernuum Linn., T. govanianum Wall., Uvularia grandiflora Sm., U. perfoliata Linn., U. pudica (Walter.) Fernald , U. sessilifolia Linn.

Group 20:
Disporum trachycarpa Benth. et Hook.

Group H

Group 21:
Heterosmilax japonica Kunth., Polygonatum latifolium Desf., P. multiflorum (L.) All., P. odoratum (Mill.) Druce., P. officinale All., P. verticillatum All., Smilax aspera Linn., S. beyrichii Kunth , S. herbacea Linn., S. laurifolia Linn.,S. californica A. Gray.

Group 22:
Behnia reticulata F. Didrichs., Eustrephus latifolius R. Br., Geitonoplesum cymosum A. Cunn., Herreria latifolia Woodes., H. montevidensis Klotzsch. H. stellata Ruiz et Pav., Rhipogonum album R. Br., R. scandens Forst

Group 23:
Dasypogon bromeliifolius R. Br., Wallaria mackerjii J. Kirk., W. nutans J. Kirk.

Group I

Group 24:
Asparagus acutifolius Linn., A. africanus Lam., A. maritimus Pall., A. medeoloides Thunb., A. officinalis Linn., A. plumosus Baker , A. sprengeri Regel, A. stipularis Forsk., A. trichophyllus Bunge., A. turkest-

Group 24: (Cont.)
anicus Popov., Danae gayae Webb. et Kunth., Ruscus aculeatus Linn., R. hyphyllum Linn., R. ponticus Woronow et Schelkownikow.

Group 25:
Acanthocarpus preissii Lehm., Asparagus falcatus Linn., A. racemosus Willd., Convallaria majalis Linn., Maianthemum convallaria (Weber) Wigg., Smilacina racemosa (L.) Desf., S. stellata (L.) Desf., S. sessilifolia Nutt. ex Baker , Streptopus strptopoides var. japonicus Fasstt.

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